

Mr. Quaintance then read his address as retiring President as follows:

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REMARKS ON SOME OF THE INJURIOUS INSECTS OF OTHER COUNTRIES.

BY A. L. QUAINANCE.

Our knowledge of the injurious insects of the world at large with the exception of Europe and one or two other regions, is, on the whole, quite meagre. During the past decade or so, it is true there has been a notable increase in the attention given by governments to the subject of economic entomology in their respective territories, and numerous publications are now appearing, dealing with the insects noxious to crops, forests, domestic animals, etc. and especially to man himself. The importance of such work in general has been perhaps the more quickly appreciated in view of the numerous brilliant discoveries in the field of medical entomology, which from the start have been of the greatest practical value. The economic investigations along various lines, now well under way, or but recently begun in many lands, will in due time make known the more noxious species with which the people of other countries have to deal.

The extent to which work of this kind has been undertaken may be judged by citing some of the countries where economic work has been or is now in progress, as Japan, Java, Straits Settlements, Fiji, Australia, New Zealand, South Africa, Natal, British East Africa, India, Ceylon, Egypt, Turkestan, Chile, Brazil, Argentina, Uruguay, Peru, British Guiana, the West Indies, Mexico, etc.

In view of our constantly increasing commerce with other nations, knowledge of their insect pests is of prime importance, as enabling us to better guard against their introduction. Aside from practical considerations, however, much scientific interest attaches to the biologic and other features of economic investigations in other countries, which contain much of inspiration and suggestions for us. The writer personally has felt the need of a greater familiarity with the destructive insects, occupying the attention of entomologists abroad; and in the belief that this feeling may be shared, to some extent, by members of this society, he has brought together for your consideration tonight condensed remarks on some of the insects which attack crops outside of North America.

Without doubt reference will be made to insects which really do not merit mention on account of their economic importance, and

species will have been omitted which should have been mentioned. It has not been possible to so thoroughly review the literature as to be reasonably sure even, of including all of the prominently injurious species, and it has often been impossible to decide upon the proper economic status of a species from the authors' remarks. These details, however, lose some of their importance when we remember that the behavior of a given species in its natural habitat does not necessarily warrant the conclusion that it would be equally or more injurious if introduced into another country, though the assumption that it would, under a new environment, maintain, or even surpass, its reputation as a pest, is unquestionably a safe one. Of special importance, however, is a knowledge of the food habits and life history of a species, which considered in connection with its original habitat and systematic position, furnish adequate grounds for conclusions as to its probable dangerous or innocuous character.

Time does not permit to dwell on the many interesting questions related to a subject of this kind, which, of itself, is too large to properly be considered in an address of this character. For instance, it would be of much biological interest, and of very probable practical value to summarize our knowledge as to what extent insects from other Zoölogical regions, as the Oriental, Neotropical, Ethiopian, etc. have adapted themselves in the Nearctic and in what life zones in North America they thrive and prove noxious. As is well known, Palearctic forms, especially European, constitute the bulk of our imported injurious pests, though many exceptions must be noted.

ISOPTERA.

Practically none of the Neuropteroid orders of insects are injurious to crops, with the exception of the Isoptera, which contains two families, many species of which are at times plant enemies, but especially of houses and other wooden structures.

The well known *Termes lucifugus* of Europe is a pest of buildings also attacking garden crops.

Termes obesus Ramb. is probably the species responsible for the large amount of damage in India to houses, crops and trees. In Ceylon *Calotermes militaris* Desn. and *C. greeni* Desn. are periodically pests of the tea plant. *Termes lacteus* Frogg. is destructive to buildings about Sydney, and in the woods, builds tall rounded nests or mounds, some of them 6 feet high. *Coptotermes gestroi* Wasm. is destructive to numerous plants in tropical Asia, as *Hevea brasiliensis*, mango, coco nut palm, etc.

In Formosa, *Termes vulgaris* Hav. is very destructive to sugar cane, the insects eating the roots and parts below the soil, often

killing the young plants. In Turkestan *Hodotermes turkestanicus* is noted for injuries to telegraph poles.

ORTHOPTERA.

Representatives of this order have been scourges to mankind from the earliest times, and accounts of their ravages occupy prominent places in entomological literature. All families, save one, contain injurious species, but the following especially merit notice.

Locustidæ (Acrididæ).

Schistocerca paranensis Burm. is the destructive locust of Argentina and surrounding regions of South America. Its distribution is given as Argentina, Brazil, Uruguay and Chile. *S. tartarica* L. (*C. peregrinum* Stal.), a similar species, and with which the above has been at times confused, is an insect of the greatest importance in northern Africa, and western Asia. It occurs in southern Europe and is recorded from South and Central America. In the Sudan this species is stated to be the most important of all insect pests to crops.

Orthacanthacris ægyptia L., the *Acridium ægypticum* of some authors, ranges over southern Europe, northern Africa and western Asia. Its history as a devastating species is too well known to require comment. Another important form, *Calliptamus italicus* L., ranges as far north as central Europe, and also inhabits northern Africa and western Asia. *Dociostaurus moroccanus* Thunb., periodically swarms over Algeria, living permanently in the higher altitudes. This species ranges over about the same distribution as the foregoing, and also occurs in Madeira.

Colemania sphenarioides Bol., the so-called "Jolo Grasshopper," and *Hieroglyphus banian* Fab. are first class enemies of cereals, rice, etc. in Mysore State, the latter occurring also in China and India. In Formosa *Oxya intricata* Stal and *O. velox* Fabr. are destructive enemies of rice, and *Gelastorhinus esox* Burr. does similar injury in Formosa, and also in Japan.

Cyrtacanthacris septemfasciata Serv. is the plague locust of Natal, central and southern Africa, and is present in Borneo. This species particularly was the cause for the foundation of the South Africa Central Locust Bureau. Another species, the brown locust of South Africa, *Locusta pardalina* Walk. is also a pest of prime importance. Some other species merit mention almost equally with the foregoing.

Anent locust ravages in northern Syria, it was stated in the daily consular and trade reports that the commission appointed by the government required every rural inhabitant to collect and

deliver at least 55 pounds of locust eggs. In this way a total of 629,882 pounds of eggs were collected.

Achetidae (Gryllidae).

In this family are several species frequently noted in economic literature. The mole cricket of the West Indies, *Scapteriscus didactylus* Latr., is excessively injurious to tobacco, sugar cane and various other crops in Porto Rico. It is present in various islands of the West Indies, and occurs in South and Central America and in Mexico. Its presence in the southern United States is a well established fact.

Gryllotalpa africana Beauv. is recorded from Asia, Africa, Australia and New Zealand. In Uganda and Formosa, it is said to be extremely injurious to rice. *Oecanthus pellucens* Scop. occurs in southern and central Europe, western and central Asia. It punctures grape canes and stems of other plants like our *O. nigricornis*.

Acheta bimaculata DeG., in Formosa, is very injurious to young vegetation of various kinds, especially cotton, tea, etc.

THYSANOPTERA.

There are many species in this order which have shown themselves in the United States and elsewhere to be formidable enemies of crops, as *Euthrips pyri*, *E. citri*, and *Thrips tabaci*. The habits of these insects, in some cases, are quite favorable to their dissemination from one country to another, and numerous species are already widely scattered over the world.

Limothrips denticornis Haliday occurs generally over Europe, and infests oats, barley, and various fruits. *L. cerealium* Haliday, the so-called corn thrips, is distributed over all Europe. It is considered by Uzel as one of their more destructive species, injuring corn, wheat, oats and grasses, the attack causing the grains to shrivel and become abortive. *Heliathrips hæmorrhoidalis* Bouché, a species which Bouché thought to be native to America, is widely distributed over Europe and occurs in Australia. It is destructive to numerous plants, and is one of our more injurious forms. *H. rubrocinctus* Giard, the cacao thrips, is spread over the West Indies, where it is one of the prime enemies of cacao, attacking the pods, tender shoots and foliage. It also injures the cushew, guava, mango, etc. and is recorded from Uganda. The insect has recently made its way to Florida.

Thrips communis Uzel, in Bohemia, injures potatoes and beets, where it is regarded as quite destructive. *T. flava* Schr. injures blossoms of pear, apple, plum, cherry, etc. and occurs on vegetables. In England, this species with *T. physopus* L. are known as pear

thrips. The former species occurs in widely separated regions in Europe and is probably generally present over the entire region.

T. minutissima L., present in England, Germany and Bohemia, is another general feeder like *flava* and has about the same distribution. *Thrips sacchari* Krueger with *T. serrata* Kobus attacks sugar cane in Java. *Stenothrips gramineum* Uzel is injurious to barley and other grains in Bohemia, while *Drepanothrips reuteri* Uzel is injurious to grape foliage in Sicily, especially to certain American varieties (Riparia). *Phloeothrips oleæ* Costa is one of the important olive pests in portions of Europe, injuring the fruit and foliage. *P. pallicornis* injures sugar cane in Formosa.

It is apparent that our knowledge of the injurious Thysanoptera is confined mostly to Holarctic forms. It is quite certain that other regions will furnish many species which, in their present or new environment, will be quite troublesome.

HEMIPTERA.

Species of the order Hemiptera are of especial interest to crop producers, for the sum total of losses for which they are responsible, would amount to no small part of that chargeable to insects as a class.

HETEROPTERA.

Pentatomidæ.

Two species of the genus *Eurydema*, namely, *ornatum* L. and *oleracea* L. are pests of cruciferous plants in Europe, and much resemble in habits and general appearance our harlequin bug. The former species occurs over most of Europe, Asia Minor, parts of Russia, Turkestan, etc. The latter is even more widely distributed and is recorded from all of Europe, Western Russia, Turkestan and Siberia.

Several species, assigned to this family, are important in Australia, as *Stilida indecora* and *Rhoecocoris sulciventris*, which, both in the immature and adult stages swarm over orange orchards, sucking sap from branches, causing the fruit to fall. *Biprorulus bibax* is also an orange pest and is known as the spined orange bug. *Philia basalis* is one of the common fruit bugs of North Queensland, and the so-called cherry bug, *Peltophora pedicellata* ranges from New South Wales to North Queensland. A similar species, *P. picta* Germ. also punctures cherries, causing the fruit to fall. In South Africa, *Bagrada hilaris*, the Bagrada bug, injures cruciferous plants like our *Murgantia histrionica* Hahn. This insect occurs over central Africa, Algeria and the Arabian Desert. *Bagrada picta* Fabr. also infests cruciferous plants in India. *Plantia affinis* Dallas infests growing rice in New South Wales.

Aenaria lewisi Scott does much damage to rice in Japan by piercing the heads. The insect is single brooded, the adults hibernating under trash in field and woodlands. *Cuspicora simplex* Walker the brown potato bug, and *C. virescens* Tryon, are potato pests in the Illawarra and Toowoomba districts of Australia.

Coreidæ.

In this family are several important species, though but few are seriously destructive. One species, the rice or paddy bug, *Lep-tocorisa varicornis* Fabr., is a serious pest to rice, ranging over Japan, China, India, Ceylon, Philippine Islands, etc.

Mictis profana, the crusader bug, is abundant in citrus orchards in Victoria and punctures the shoots, blighting the twigs, often causing the crop to fall.

Lygæidæ.

Nysius vinitor Bergroth, the Ruthergren bug of Australia, punctures fruits, as grapes, peaches, and the like, causing them to rot, and is considered one of the most destructive plant bugs on that continent, swarming over fruit and foliage in countless millions.

Oncopeltus quadriguttatus, the cotton bug, is common on cotton in the Richmond River section and ranges from Sydney to Queensland. *Oxycarænus latus* Kirby is a cotton pest in many parts of India. Only twelve days are required from egg to adult.

Pyrrhocoridæ.

This family is of interest principally on account of several members of the genus *Dysdercus*, which contains species quite injurious to cotton in various parts of the world. There are some four or five Nearctic species and a single one from the Palearctic region, *D. crucifer* Stal occurring in Japan, the Philippines, etc. Some twenty species occur in the West Indies and South and Central America.

Dysdercus sidae infests cotton in New South Wales, staining the cotton fleece with its excrement, in common with the other forms of the genus, which seem always to infest cotton when grown within their range of distribution. *D. cingulatus* Fabr. is abundant on cotton in India, while *D. fasciatus* Sign. is the cotton stainer bug of South Africa, occurring also in Portuguese East Africa. Another species, *D. superstiosus* frequents cotton on the Cape. *D. insularis* and *D. pacifica* occur on cotton in Fiji, but have not as yet caused much trouble. Certain species are pests to the south of us, i.e., *D. ruficollis* L., in Peru; *D. howardi* Ballou, considered quite important in Trinidad and Tobago; and *D. andreae* L. in Cuba. *D. delauneyi* Leth. is common in the Southern Islands. The harle-

quin bug of Australia, *Dindymus versicolor*, is a Pyrrhocorid and punctures ripe fruits.

Tingitidæ.

Urentius echinus Dist. occurs on egg plants in India, though not as yet troublesome. The olive tree bug, *Froggattia olivina*, of New South Wales, has turned its attention from the wild to the cultivated olives, sometimes defoliating the trees. *Stephanitis (Tingis) pyri* Fabr., which inhabits Europe, Asia Minor, Russia, Japan, etc., is injurious to foliage of pear and is mentioned in most European works on economic entomology.

Capsidæ.

In this extensive family, the species mostly live on plants and a few are of importance. The famous mosquito blight of tea in India and Ceylon is due to *Helopeltis theivora* Waterhouse while *H. bradyi* Waterhouse injures cacao in Java. *Disphinctus politus* Walker attacks the betel vine and *D. humeralis* Walker injures Chincona, in India. *Gallobellicus crassicornis* Distant, is a garden pest in Bombay, and in Pusa, attacks and breeds on tobacco.

Calcoris angustatus Leth. attacks sorghum in South India. *C. trivialis* Costa injures the olive, vegetables, etc. in portions of southern Europe, and is present over northern Africa.

HOMOPTERA.

Cercopidæ.

The Cercopidæ, though not numerous in species, are widely distributed over the world, though not many are troublesome to crops.

Tomaspis varia Fabr., the sugar-cane frog hopper, is just now attracting considerable attention in Trinidad and Tobago. The young feed on roots of the sugar-cane plant, following these in cracks in the soil, and the adults feed on the the leaves. *T. postica* Walker occurs on sugar-cane in Mexico. *Philænus spumarius* L. injures the sugar beet in Bohemia. *Ptyelus costalis* Wk. is a pest of rice and sugar cane in Formosa.

Jassidæ.

This family has been but little worked in the newer parts of the world, though a few important species are to be mentioned as crop pests. *Nephotettix apicalis* Motsch. is a serious enemy of rice in seed beds in Japan and Formosa, and has caused a loss of \$10,000,000 in a single year. The species ranges over Japan, China, Cey-

lon, the Philippines, etc. Another Jassid injuring rice in India is *Tettigoniella spectra* Dist. Three species of *Idiocerus* injure the shoots of mango in Saharanpur, namely, *I. clypealis* Leth., *I. niveosparsus* Leth. and *I. atkinsoni* Leth. *Chloritia (Eupteryx) solani* Kollar is the potato frog fly of England, as stated by Miss Omerod. *Thamnotettix fuscovenosus* Ferr. occurs in Italy, Corsica, Greece, Austria, etc., and in some regions injures the olive. *Typhlocyba viticola* Targ. injures the grape in Italy, as does *flavescens* in northern Africa. In Bohemia several species of Jassids injure the sugar beet, as *Cicadula sexnotata* Fall., *Eupteryx atropunctata* Goeze, etc. *Zygina subrufa* Motsch., *Deltocephalus dorsalis* Motsch. and *Strongylocephalus agrestis* Fall. attack rice and sugar cane in Formosa, the latter species injuring the same crops in Japan.

Fulgoridae.

A notorious species in this family is *Perkinsiella saccharicida* Kirk., the sugar-cane leafhopper, which, on account of its injuries, led to the establishment in Hawaii of the Entomological Division of the Sugar Planters' Experiment Station. The pest is thought to have been introduced from Australia, and is known to occur in Java. Several other species injure sugar cane, as *Phenice moesta* Westw. and *Pyrilla aberrans* Walk., in India, and *Delphax saccharivora* West., which some years ago was troublesome in the West Indies. *Liburnia (Delphax) psylloides* Leth. injures corn in Ceylon and India. *Ricania zebra* Dist., in the same region, infests rice and grasses.

Hysteropterum grylloides Fabr. infests the olive, in Italy, and is general over all of southern Europe. Another European form is *Hyalesthes obsoletus* Sign. injuring young olives. *Dictyophora pallida* Dor. is the sugar cane fly of India, and is common in the Punjab, United Provinces, and Behar. Cane is said to be its only food plant.

Psyllidae.

The injurious members of this family are mostly of the genus *Psylla*, and numerous forms of decidedly economic importance occur in the Palearctic region. Thus, *Psylla mali* Schmidbg. ranges pretty well over Europe, and is a decided pest of apples. In England it is known as the apple sucker, where it is considered one of the worst of all pests to this plant. *P. crataegi* Schr. occurs over Europe generally on apples and *Crataegus*. *P. pruni* Scop. is also distributed over much of Europe, including Siberia. It attacks plum and prunes. *P. pyri* L. occurs on pear and has about the same distribution as the foregoing. *P. pyrisuga* Forst., also attacking pear, occurs over much of Continental Europe, and is

also found in Japan. In France it is known as the orange *Psylla* on account of injuries to oranges. *P. cistellata* Buckton causes galls on mango in Dehra Dun. *Trioza obsoleta* Buck. attacks the persimmon in Thana and a species of this genus injures the young growth of citrus trees in South Africa, where it is known as the citrus *Psylla*. *Mycopsylla fici* is found on native figs in Australia. the larvæ hiding under the abundant milky sap which exudes from the punctures made. *Homotoma ficus* L. attacks the foliage of fig in Italy, the species being present also in Spain, France, Dalmatia, etc. The olive *Psyllid*, *Euphyllura olivina* O. Costa injures the olive and has about the same range as the preceding species.

Aleyrodidæ.

The *Aleyrodidæ* is a family of wide distribution in the temperate and tropical parts of the world. Many species have already attracted attention by their injuries and a few constitute quite destructive pests. *Aleyrodes citri* and *A. vaporariorum* may be cited as examples of very undesirable introductions already effected.

Two species injure tobacco, namely, *Aleyrodes tabaci* Gennadius, in Greece, and *A. nicotianæ* Maskell in Mexico. Sugar cane in Java is attacked by three species, namely, *Aleyrodes bergii* Signoret, *A. longicornis* Zehntner, and *A. lactea* Zehntner. The guava in Brazil is infested with *Aleyrodes horridus* Hempel and *A. goyabæ* Göldi. *Aleurodicus cocois* Curtis is a guava pest of importance in Trinidad, Venezuela and Brazil, and has long been known as troublesome to cocoanut palms in portions of the West Indies. A closely related species, *A. destructor*, seriously infests this plant in the Philippines.

In Europe, *Aleyrodes brassicæ* Walker has long been known as more or less destructive to cabbage, kale and other members of the cruciferous family. *Aleyrodes youngi* Hempel seriously infests cabbage in Brazil. *Aleyrodes ribium* Douglas occurs on red and black currants in England. Many other species might be mentioned as of possible or actual economic importance in foreign countries.

Coccidæ.

The *Coccidæ*, as a family, is of the greatest economic importance. The mode of life of the species favor their wide dissemination, and very many are now practically cosmopolitans. In this family especially it is difficult to surmise the behavior of a species introduced in a new environment, with abundance of food, etc. Mr. Sasser has kindly assisted me in the selection of a few forms, not yet found in North America, and which are evidently of importance in their present range of distribution.

Icerya seychellarum West., attacks sugar cane, guava, palms, citrus etc., and occurs in New Zealand, China, Madeira, Mauritius, etc.

Phenacoccus oleæ Marchal, is an olive pest in Tunis.

Pseudococcus sacchari Ckll. infests sugar cane in Cuba, Porto Rico, South America and probably elsewhere.

Pseudococcus perniciosus Newst. & Wilcox is a mealy bug very injurious to the lebbek in Cairo, Egypt, where the tree is grown for shade. It also occurs on the Christ's Thorn and Sunt.

Coccus (Lecanium) viride Green., the so-called green bug of Ceylon, infests a long series of useful plants, but is especially destructive to coffee. Its ravages to this crop have been practically responsible for the abandonment of its cultivation over the greater part of the planting districts of Ceylon.

Lecanium krügeri Zehnt., attacks cane in Java.

Three species of *Chionaspis* are Javanese cane pests, namely, *C. depressa* Zehnt., *C. sacchari-folii* Zehnt. and *C. madiensis* Zehnt.

Parlatoria pyri Marlatt occurs on pear and apple in Manchuria. From its affinities, it must be regarded as a suspicious character.

Aspidiotus oceanicus Lindinger is a pest of the coconut in the South Sea Islands, and *A. lauretorum* Lindinger, in the Canary Islands, infests a long list of plants, including Smilax, Hedera, Laurus, etc. *A. destructor* Sign., of very wide distribution outside of North America, occurs on the banana, coconut palm, tea, mango, and many other useful plants. *A. sacchari* infests sugar cane in Java.

Aspidiotus africanus Marlatt, of South Africa, is seriously destructive to the privet and fig, and infests, to a less extent, other cultivated plants, as apricot, quince and apple. It is also abundant on honey locust and pepper tree.

Leucaspis japonica Ckll., occurs in Japan, China, and South Africa, infesting apple, pear, maple, magnolia, etc.

LEPIDOPTERA.

In this order, practically all of the families contain species more or less important economically, though the actual number of families containing notably destructive forms is much less.

Nymphalidæ.

Brassolis isthmia Bates, the cocoanut palm butterfly is a troublesome enemy of its host plant in the Canal Zone.

Lycanidæ.

Virachola isocrates Fabr., in India, works havoc in pomegranate plantations and also injures guavas. *Zizera labradus* Godt. has

come into notoriety in Victoria by reason of its injuries to beans and peas. *Thecla pruni* L. injures plums in portions of Europe, but is not of much importance.

Hesperiidæ.

Three species of this family are noted as destructive in India. Larvæ of *Gangara thyrsis* Mo. are injurious to palms. The rice skipper, *Parnara mathias* Fabr. is at times destructive to rice, there being two broods on rice during the rains. *Telicota palmarum* Mo. occurs on date palm, and is widespread in India.

Castniidæ.

A single species of this interesting South American family is to be noted, namely, the giant sugar-cane borer, *Castnia licus* Drury. It is quite destructive to sugar cane in British Guiana. It has been collected in various localities in the northern half of South America and also in Nicaragua, Costa Rica and Trinidad, where it also attacks the banana. This species is also reported from Surinam. The larvæ tunnel the canes, producing the so-called "dead heart."

Notodontidæ.

Phalera bucephala Steph., the buff-tip moth, in England, is troublesome to many shade and fruit trees, including nuts. It occurs over Europe, except the polar region, Siberia, etc.

Thaumetopæidæ.

A single species, *Thaumetopæa processionea* L., the so-called procession caterpillar of Europe is here to be noted. These caterpillars defoliate oaks, hard wood trees, and even attack field crops, as potatoes, beans, flax, etc. The species is evidently quite important to forests, and is interesting on account of the habits of the larvæ, which, after they are about half grown, return after feeding, to definite localities on the tree trunk, usually a depression or other deformity.

Lymantriidæ. (Liparidæ).

To this family belong some of our most notorious injurious insects, namely, the gipsy and brown-tail moths, tussock moth, etc. Here also belongs the famous "nun" moth of Europe, *Lymantria monacha* L. The caterpillars are polyphagous, but especially frequent coniferous and hard wood trees. This species, judging from literature, is one of the highly injurious European insects. The "nun" moth ranges over central and northern Europe, except the polar region, northern Italy, Greece, Japan, etc. Another

polyphagous species is *Porthesia similis* Fuessl. with about the same distribution as *L. monacha*. It is often very destructive to fruit trees. *Euproctis subflava* Brem. is very destructive to fruit trees of all kinds in the Punjab, and probably elsewhere over its range, in Japan, Corea, portions of China, Usuri, etc.

Dasychira pudibunda L. is also a species of unsavory reputation in Europe and widely spread, occurring in central and northern Europe, Japan, China, etc. *Orgyia gonostigma* F. should also be mentioned in this connection and has about the same range as *D. pudibunda*. In New South Wales, *Teia anartoides* Walker is regarded as a serious pest, feeding on Acacias, roses, cherry, etc. *T. contraria* Walker, the bag shelter caterpillar, is reputed to kill stock, the hairs of the caterpillars being eaten in grazing, cause ulcerations of the mucous membranes.

Lasiocampidæ.

Malacosoma neustria L. makes its tents on various plants, as oak, elm, fruit trees, roses, etc., occurring pretty generally over Europe except the polar region, and is present in western Asia, Siberia, China, Japan, etc. *Gastropacha quercifolia* L., spread over Europe, is at times of importance to fruit trees, as is *Pæcilocampa populi* L. and *Odonestis pruni* L. *Lasiocampa trifolii* Esp., occurs on clover, etc., in Europe and occurs also in England, and portions of Asia Minor.

Noctuidæ.

This large family, as would be surmised, contains many highly injurious forms in different parts of the world.

Charæas graminis L. is from time to time very abundant and destructive to meadows in portions of Europe, the larvæ eating the roots of grasses. It is usually noted in devastating numbers in the mountain districts.

Manestra composita L., the army worm of New Zealand, seriously injures various grains and grasses. *Dianthoecia compta* occurs over central and southern Europe, and includes in its food violets and carnations. *Diloba cæruleocephala* L. injures cherry, plum and apple in England, occurring also in Europe and Asia Minor. *Hadena brassicæ* L. has a wide range, as Europe, Siberia, Japan, India and South America. *Prodenia littoralis* Bdv. is a serious pest of cotton in Uganda, Cape Colony, and Egypt, and occurs in the Canaries, Asia, Central America, etc. *Gortyna ochracea* Hubn. mines the stalks of Irish potatoes in Ireland, and occurs over central Europe, in Italy, Russia, Corsica, etc. *Nonagria inferens* Walk. bores the stems of rice in Formosa, while *N. uniformis* Dgn. is the cause of much complaint in India during the cold weather from its boring of wheat stems. *N. exitiosa* Oll. is said to be

the most destructive of all pests of sugar cane in New South Wales. *Spodoptera mauritia* Bdv. appears in great abundance on rice and grasses during the rains, or soon after, in India and has also been reported as quite destructive to Batangas rice fields in the Philippines. It is known as a pest also in Borneo. This species also attacks tobacco and vegetables. *Calamistis fusca* Hamp. (generally referred to as *Sesamia*) is a first class pest of corn in the Transvaal, Natal, Cape Colony, Rhodesia, etc., while *Sesamia cretica* Led. is one of the worst of all pests to corn and sugar cane in Khar-toum. It ranges over Egypt, southern Europe, Asia Minor, etc. The larvæ bore into the stems of the young plants, later attacking the ears of corn.

Teniocampa incerta Hbn. feeds on apple foliage and fruit in England; willow, oak and sloe are, however, its normal food plants. The species is distributed over much of Europe, Siberia, etc., and is recorded from North America. Two species of *Xylina*, namely, *ornithopus* Rott. and *socia* Rott. injure plums in Europe and have a wide distribution in the Palearctic region. In India, *Heliothis assulta* injures tobacco. In the same country the green shoots of the egg plant are bored by *Eublemma olivacea* Walk. *Thalpocharis scitula* Rmbr. is noteworthy among Noctuids as feeding on scale insects in Italy. *Plusia chalcytes* Esp. feeds on foliage of peas, beans and potatoes in Australia, while *P. agramma* Guen. feeds on Cucurbits in India. *P. nigrisigna* Walk. is also a common pest in India, feeding on lucerne, peas, etc. *Cirphis leucosticha* Hamp. is the East African cob worm and eats the ears of corn, as does our common bollworm (*Heliothis obsoleta*). *Diparopsis castanea* Hamp. is the Sudan cotton bollworm, where it was probably introduced. It is also known from Beira, Delagoa Bay and Uganda. *Sacododes pyralis* Dyar, an allied species of South America, has similar habits. Larvæ of *Ontoptera intricata* Walk. are said by French to be the most destructive of grass-eating grubs known to him. The females lay from 500 to 700 eggs each. Larvæ construct tunnels which they leave at night to feed. *Naranga diffusa* Moor is a pest of rice and grasses in Formosa.

One group, of the Noctuidæ, (*Aphiderinæ*) contains several highly interesting and destructive forms, from the habits of the moths of piercing with their especially adapted probosces, ripe fruits, in order to feed on the juices.

Menas salamina Fabr. occurs in portions of Australia, as does *Orthreis fullonica* L. and is further distributed to Africa, India, Ceylon and the New Hebrides. *Argadesa materna* L., *Cosmophila erosa* Hbn., *Egybolia vaillantina*, *Sphingomorpha chloreia*, *Ophiusa lienardi* are other names for fruit piercing moths mentioned in literature as troublesome in Australia or South Africa. *C. erosa* is also recorded from the United States.

Agaristidæ.

A single Agaristid is to be noted. *Phalenoïdes glycine* Lewis, a serious vine pest in Victoria, where it may have been introduced.

Geometridæ.

Cheimatobia brumata L., known in England as the winter moth, is a fruit pest of importance in Europe. The larvæ feed on most forest trees (except conifers), hedgerows, etc. The insect strongly resembles our American canker worms, the females being wingless. This species ranges over central and northern Europe, southern and western Russia, Greenland, etc. *Chlorolystis rectangulata* L. is the so-called green pug moth, occurring pretty well over Europe. In Ireland it is troublesome to apples. *Abraxas grossulariata* L., the magpie moth, is especially troublesome to the currant, though fruit trees are attacked. Its distribution is very wide, as Europe, Siberia, China, etc. *Hibernia defoliara* Clerck is often damaging to fruit and other trees in Europe and is generally referred to in European textbooks. *H. rupicaprararia* Hb. is also of wide distribution, and apparently of about the same importance. *Anisopteryx æscularia* Schiff. is an orchard pest in Europe, and in England is called the March moth. Its usual food is white thorn and black thorn, but it infests oak, elm, maple, etc. *Biston græcorius* Stgr. is a pest of forage plants and occurs in Italy, Greece, Macedonia, etc. *Biston suppressaria* is a caterpillar pest of tea, injuring this plant periodically in India. *Hemerophila atrilineata* injures mulberry seriously in Japan, interfering with the silk industry.

Cymbidæ.

Earias insulana Bvd. is the Egyptian cotton bollworm, or the spotted bollworm of India, causing a yearly loss in the former region of about \$5,000,000. It attacks most malvaceous plants. It is recorded from North and South India, Burma, Siam, Australia, Mauritius, Uganda, etc. *Earias faba* Stoll, also known as the spotted bollworm, has similar habits, though in India it is more abundant than the former species. The larvæ bore into cotton bolls and feed on the oily seeds. In the absence of bolls, the shoots are tunnelled. In warmer parts of India the insect may go through its life cycle in about thirty days, and they are active throughout the winter.

Zygaenidæ.

Levuana iridescens Bet.-Baker, the coconut leaf moth, has for many years been a destructive insect enemy of the coconut and Royal palm in Fiji. It is apparently yet limited to these Islands.

Sesiidæ.

Sesia myopæformis Bkh. infests the trunk and branches of apple trees in Europe, as does *S. pyri* in North America. *Trochilium crabroniformis* Lewin is injurious to osiers, the larvæ boring the stumps. It is recorded from England, Germany, Austria, etc.

Cossidæ.

Cossus cossus (ligniperda) L. bores the trunk, limbs and branches of shade, park and forest trees, as well as orchard trees. According to Taschenberg 266 larvæ were taken from one pear tree, while from 20 to 30, in individual forest trees is usual. The species is widely distributed, as much of Europe, Syria, Korea, etc. A near relative, *Zeuzera pyrina* L. is now established in the United States. *Z. coffeæ* Nietn. bores coffee stems in India, while *Cossus tristis* Drury bores the wood of apple and quince in South Africa.

Hepialidæ.

Hepialis lupulina L., the garden swift moth of England, does great damage to roots and stalks of plants, as well as bulbs and corms. The larvæ attack also the strawberry. It occurs over central Europe, Scandinavia, Italy, Dalmatia, etc. *Hepialus humuli* L. is a pest of the hop plant, the larvæ tunnelling the roots. It occurs pretty well over northern and central Europe. Larvæ of *Charagia lignivora* Lewin bore apple-trees in Victoria, while in Australia larvæ of *Pielus hyalinatus* and *P. imperialis* live in the roots of trees.

Pyralidæ.

Chilo simplex Butl., *C. zonellus* and *C. partellus* Swimb. are pests of cane, corn, sorghum, grass, etc. in India and Formosa, as is *C. fuscateilus* Sn. in Java. The larvæ bore the stems of the plants. *Diatræa striatalis* Snellen bores sugar cane in Java, like our *D. saccharalis*, and is one of their most important pests. A related, or perhaps the same species, *D. auriflua* Zell. similarly injures cane in India. *Diatræa canella*, *D. lineolata* with *D. saccharalis* injure sugar cane in Trinidad. *Heterographis bengallela* Rag. tunnels the fruit of the custard apple in the region of Calcutta and *Euzophera perticella* Rag. is a wide-spread pest of the egg plant in the plains of India, the larvæ boring the lower stems, while another species, *Leucinodes arboralis* Guen. infests the fruit. *Nephopteryx rubrigonella* Rag. is the pear fruit borer of Japan and is very destructive to this crop. *N. sagitifereilla* Moore, similarly bores citrus fruits in Perak and the Malay Archipelago generally. *Phycita infusella* Meyr is widely spread over India, and is known as the cotton bud moth on account of its injuries to cotton. *Nymphula depunctalis*

Dup. is common in India and feeds on foliage of rice. The larvæ make cases of leaves and are able to live either in air or water. *Godara comalis* Guerin, infests, in Australia, the leaves of turnips and horse radish. and in the same country *Conogethes punctiferalis* Guerin, attacks ripening peaches, eating into and webbing over the surface, and pupating at the pit. *Dichochrosis punctiferalis* Guerin is quite injurious to castor beans in India, the larvæ boring into the stems and seeds, often causing much loss. *Pyrausta nubilalis* Hb., ranging over central and southern Europe, Asia Minor, southern India, etc., is destructive to hops in Europe, the larvæ boring the stems of the plants. *Scirpophaga intacta* Sn., in Java, injures sugar cane, the larvæ boring the terminal roll of leaves and also the stem. *Sylepta derogata* Fabr. and *Phycita infusella* Meyer, are both cotton pests in India, the former feeding on the leaves, which it rolls, and the latter on the buds of the shoots, folding the young leaves together, which renders its detection easy. *Glyphodes indica* Saund., which much resembles our melon caterpillar, has in India about the same habits, the larvæ defoliating melon and allied plants. *Micromima olivia* in Cuba rolls and eats the leaves of tobacco in the seed beds, attacking also the egg plant.

Tortricidæ.

This family contains some of our most destructive insects and species of importance in other countries should be looked upon with suspicion.

Omphisa anastomosalis Guen. is quite destructive to sweet potatoes in Formosa and has recently been introduced (1900) in Hawaii, the larvæ boring the roots and tubers. *Capua angustiorana* Haw., ⁷⁴⁵ the small apricot and vine moth, is destructive to these crops in England. It occurs over central and western Europe, in Asia Minor, northwest Africa, etc. *Tortrix excessana* Walker, native to New Zealand, injures the foliage and fruit of the apple, the latter being tunnelled in all directions, and for this reason is known by some as the railway bug. *Tortrix ashworthana* Newm. (= *Cacacia responsana*), in Victoria, bores into apple much like our *Carpocapsa pomonella*, with which it has been confused. This is regarded as a serious pest by reason of the character and amount of damage to apples. *Tortrix divulsana* Walker, (= *Tortrix glaphyrana*), the lucerne moth, is a regular pest in New South Wales, the larvæ feeding on and webbing together the tips of its food plant. *Pandemis ribeana* Hb., *P. heparana* Schiff. *P. podana* Sc. and related species in England infest various orchard trees often seriously. These are insects of wide distribution in the Palearctic region. *Clysia ambiguella* Hb. is one of the first class pests of grapes in France at the present time, the larvæ eating the blossom clusters, and later

boring into the berries. This pest has a wide distribution over Europe, except in the polar region and occurs in Asia Minor, India and Japan. Two species of *Olethreutes*, namely, *cynobatella* L. and *pruniana* Hb., are worthy of mention as injuring buds, young leaves and blossoms of orchard trees in various parts of Europe, working much like the bud moth, *Tmetocera ocellana* Fabr. now well established in the United States. *Polychrosis botrana* Schiff. corresponds to our grape berry moth *Polychrosis viteana* Clemens, and it was long supposed that ours was the European species. This latter ranks as a vine pest in France with *Clysia ambiguella*, earlier mentioned, and is widely distributed over southern Europe. *Notocelia roborana* Tr. infests currant fruit in England, at times seriously, the larvæ hollowing out the ripening fruit. It ranges over Europe, except the polar region. Several species of *Laspeyresia* (*Grapholitha*) in Europe are troublesome insects and would probably prove very undesirable introductions in the United States. Larvæ of *L. woerberiana* Schiff. bores the bark of cherry, plum, apple and peach trees. *L. funebrana* Tr., the red plum maggot of England, attacks fruit of plum in England and in the caterpillar state is said to be plentiful in plum pies. It would doubtless be very damaging to our prune industry on the Pacific coast. It occurs over central Europe, Scandinavia, Italy and Asia Minor. *L. dorsana* F. has about the same distribution and is of importance by reason of its injuries to peas. *Laspeyresia schistaceana* Sn. is an important sugar-cane pest in Java, the larvæ boring into the more tender shoots. *Carpocapsa splendana* Hb. is a serious pest of walnut and chestnuts in Europe. The normal food is said to be acorns. It occurs in central and southern Europe, Sweden, England, etc. *C. amplana* Hb. infests hazel nuts, walnuts, etc., etc., occurring in Germany, Austria, northern and central Italy. The so-called Natal codling moth, a species of *Carpocapsa*, is a serious enemy of guavas, oranges and mandarines in that country. *Simathis nemorana* Hb. infests figs, and occurs in southern Europe, Asia Minor, Madeira, Mauritius and is reported from Canada. *Paramorpha aquilina* Meyrick has come into notice as an orange pest in Australia. The larvæ bore through the skin and feed on the pith between rind and flesh. *Cryptophaga unipunctata* Donovan is the cherry borer of Australia. The larvæ are said to be excessively destructive to cherry and peach trees, and some times to plums. Galleries are eaten under the bark, the larvæ later boring into the heart of the tree. *Amorbia emigratella* Busck, thought to be native to Mexico and Costa Rica, has recently appeared in Hawaii and is known as the leaf roller of sweet potatoes. It also attacks many kinds of shrubs and fruit trees.

Yponomeutidæ.

A few forms in this family require mention. *Yponomeuta malinellus* Zell. *Y. evonymellus* L. and *Y. padellus* L. are recognized as of considerable importance to orchardists in England and portions of Europe, especially the first mentioned, which has just made its appearance in the United States near Geneva, N. Y. *Y. padellus* feed on plum and cherry in France, and on plum in Italy. *Prays citri* Mill. infests the orange in Corsica, Sicily, Ceylon and Australia, and recently it has been received from the Philippines. *P. oleelus* F. injures foliage of olive in Italy, and ranges over the Mediterranean region, where the olive is cultivated. In the genus *Argyresthia* are several suspicious characters. *A. conjugella* Z. is already established in British Columbia and has been taken in the Puget Sound region in Washington State. The slender larvæ tunnel apples and other fruits. It ranges over central and southern Europe, Asia Minor, Japan, etc. *A. nitidella* Fabr. is the cherry fruit moth of England, the larvæ burrowing in the fruit. *A. ephippella* F. feeds on the shoots of cherry, the leaf and blossom buds of wild plum, also on the hazel. *A. cornella* F. attacks the leaf buds of apple.

Gelechiidæ.

Gelechia gossypiella Saund. is another serious cotton pest and is almost universally distributed over India, Ceylon, Burma, Straits Settlements and East Africa. It has just now been found in Hawaii. It is known as the pink bollworm, and is generally associated with the spotted bollworms. The larvæ also bore into the bolls and feed on the oily seed. *Anacamptis nerteria* Meyr. is injurious to ground nuts in Ceylon and South India, and is apparently quite important. *Anarsia ephippias* Meyr. also feeds on the ground nut in India and has been taken only during the rains. It feeds upon and rolls the leaves together.

Elachistidæ.

The pith moths, *Blastodaena hellerella* Dup., and *B. vinolentella* H. S. are insects whose larvæ cause a good deal of damage to apple trees, especially nursery stock. The larvæ bore into the buds, spurs and shoots, thus causing the foliage and shoots to die. The species work something like our *Epinotia pyricolana* Murtf. *Antispila rivillei* Stt. injures grape foliage like our *A. isabella* and occurs in northern and middle Italy and Dalmatia. *Coleophora anatipennella* Hbn. the cherry case bearer, injures cherry buds in the spring time in England and occurs over central and northern Europe. *C. flavipennella* HS. injures pears in Europe in a similar way, while *C. hemerobiella* Z. feeds on apple, pear and cherry,

Blastodacna atra Haw. is the apple fruit borer of Japan and is one of their most troublesome pests.

Lyonetiidae.

Lyonetia clerkella L. mines apple leaves in Europe, but is not especially important on account of the character of injury. The species occurs over central and northern Europe, central Italy, Sardinia, etc. *L. prunifoliella* Hb. similarly mines plum and cherry leaves, and has a wider distribution than the former. *Cemistoma scitella* Z. mines apple and pear leaves, occurring over central and northern Europe, Dalmatia, Italy, etc. *Cemistoma coffeella* Perrottet is the coffee leaf miner of the West Indies. It has been introduced into Brazil and other coffee growing regions of the Western Hemisphere and does much damage to this crop. In Porto Rico, for example, it was held to have caused a loss of from \$150,000 to \$300,000 during 1904.

Tineidae.

Incurvaria rubiella Bjerk., known as the raspberry moth in England, is important, the larvæ boring the shoots, thus lessening or destroying the crop. It is present in central and northern Europe, Corsica, Dalmatia, Russia, etc. *Incurvaria capitella* Clerk injures the fruit and shoots of the currant and ranges over central Europe, Norway, Sweden and Western Russia. *Gnorimoschema heliopa* Lower is a serious enemy of tobacco in India, Ceylon and Java, the larvæ boring the stems, causing gall-like swellings. *Ereunetis flavistriata* Walsm., is the Hawaiian sugar-cane bud moth, the larvæ also eating the dead leaves of palms, bananas, pineapples, and sometimes eating the skin of the banana fruit. The peach moth of Japan, *Carposina persica* Sasaki is one of the very destructive insects of this crop, more than 90 per cent being injured during some seasons.

Thyllocnistis citrella Stainton
 C. eximius on Citrus, Philippines & India.

DIPTERA.

Tipulidae.

Several species of this family are referred to in European literature and are evidently of considerable importance. The larvæ of *Tipula oleracea* L. injure various root crops, as well as those of *T. paludosa*. *Pachyrhina maculosa* Meig. has a record of serious injury to tulip bulbs in England.

Cecidomyiidae.

Dasyneura anophila Haimh. is a gall maker on grape foliage, occurring in central Europe and the Mediterranean region. *D.*

pyri Bouché, the pear leaf curling midge is distributed over central and northern Europe, though it has as yet attracted but little attention by its injuries. *Asphondylia lupini* Silv. injures lupines in Italy, the maggots infesting and aborting the seed pods. This species was reared from its host by Coquillett at Los Angeles. *Mayetiola avenæ* March. injures wheat in southern Europe much like its cogener, *M. destructor*. *Contarinia nasturtii* Kieffer, the so-called "swede midge," infests swedes in Ireland, the maggots occurring at bases of leaf stalks. It occurs on various cruciferous vegetables in Europe. *C. gossypii* Felt infests the flower buds of cotton, causing the bracts to flare and squares to drop. This pest appeared in Antigua in 1907, and caused very serious losses at the time. It is apparently still confined to that Island. *Cecidomyia oryzæ* Wood Mason has been destructive to rice in Bengal. *Parricondyla gossypii* Coq. is a pest in Barbados, and is present in Montserrat. The red maggots occur under the bark of the stems of the cotton plant, which they may completely girdle, causing the death of the portion above the infested area.

Bibionidæ.

The larvæ of *Bibio hortulanus* L. live on the roots of various garden and other crops in Europe, the species also occurring in northern Africa and Asia Minor.

Syrphidæ.

The Narcissus fly, *Merodon equestris* Fab., in Europe, is injurious to bulbs of narcissus, daffodil and amaryllis. The species is now well established in British Columbia.

Anthomyidæ.

We have already received from Europe several of the injurious species of this family and other forms are yet to be introduced. *Pegomyia hyoscyami* Panz. infests the foliage of garden vegetable as beets and spinach, though apparently it is not of great importance at the present time. *P. betæ* Curtis, in England, is noted as of increasing economic importance and is just now doing a good deal of injury to beets. The larvæ attack the mesophyll of the leaf. There are two or even three broods each year.

Trypetidæ.

The Trypetid family of flies is one of almost world-wide distribution and contains many species of the greatest economic importance, as the so called fruit flies. These are especially destructive for the reason that thus far no remedies have been developed which

are of much value in lessening attack. With the exception of the *Rhagoletis pomonella*, no species is as yet notably destructive in the United States, though the notorious Mediterranean fruit fly, *Ceratitis capitata*, is well established in the Territory of Hawaii. Other dangerous forms are in the West Indies, some of them perhaps already established in South Florida. The family is especially rich in species in Africa, the East Indies and Australia, and in the latter country constitute a veritable scourge to certain crops.

Ceratitis capitata Wied., is now pretty well distributed over the tropical and subtropical parts of the old world and occurs in Australia, South Africa, Brazil, Bermuda, Hawaii, etc. It infests practically all soft fruits, and numerous sorts of vegetables. It is notably injurious to peaches, oranges and guavas, but infests several dozen other fruits, vegetables and wild fruits. *Ceratitis anonæ* Graham injures guavas and the sour sop, in West Africa, while *C. punctata* Wied. injures pods of the cacao in the same region. *C. catoirei* Guerin, considered by some identical with *capitata*, infests oranges in Mauritius. *C. rubivora* Coq., the Natal fruit fly, injures all sorts of cultivated fruits and is extending its range over South Africa. It apparently ranks as a pest close with *capitata*.

The genus *Dacus* also contains a consideration number of forms highly destructive. *D. tryoni* Froggatt, the Queensland fruit fly, infests the banana, mango, peach, nectarine, orange and most other fruits. It is evidently a pest of first importance and ranges from India and Ceylon to Java, Amboina and Australia. *D. ferrugineus* Fabr., the mango fruit fly, also infests oranges, mangoes and other soft fruits and occurs in India, Java and probably many of the Islands of Malaysia. It is thought to have been recently introduced in the Philippines. *D. cucurbitæ* Coq., the melon fruit fly of India, Ceylon and Hawaii, infests most disastrously cantaloupes and watermelons in its range of distribution. *D. bipartitus* Graham, a West African species, attacks especially cucurbits, though it is not regarded as a serious pest as yet. *D. persicæ* Bigot, the peach fruit fly of India is very injurious to peaches, oranges, mangoes, etc. *D. psidii* Froggat is the South Sea guava fly, and is known from Fiji and New Caledonia. The Sudan fruit fly is also a *Dacus*, the species not yet having been determined apparently. *Dacus oleæ* Rossi is an old time enemy of the olive in the Mediterranean region, including northern Africa and the Canary Islands. It is one of the prime pests of the olive in its territory. The Baluchistan fruit fly, *Carpomyia pardalina* Bigot, is also a melon pest of importance. *Anastrepha serpentina* Wied. and related species infest guava sapadillos, etc., in the Lesser Antilles, while several species of this genus infest fruits in South America, as *A. striata*, *fratercula*, *serpen-*

tina, etc. *Anastrepha ludens* Loew is, of course, the principal pest of orange fruit in certain States in Mexico and was the occasion of the quarantine by California of Mexican oranges. *Trypeta musæ* Froggatt, the Island fruit fly, infests bananas and other fruits in the New Hebrides and has been introduced into Australia. *Acidia heraclei* L. occurs in Europe and Asia Minor, and mines the leaves of celery. *Platyparea paciloptera* Schrank occurs over central Europe and is destructive to asparagus. The female fly deposits her eggs on the tips of the young shoots, the resulting maggots living beneath the skin and tunnelling towards the base of the plant. It remains to mention a fly of the family Lonchæidæ, *Lonchæa splendida*, present in New South Wales, Victoria, New Zealand and the Pacific Islands, which infests tomatoes, after the manner of fruit flies.

Oscinidæ.

The Oscinidæ include several species which in Europe are exceedingly troublesome to small grains. *Chlorops tenuipus* Meigen causes the affection known as "gout" on account of the swollen condition of the heads. The maggots are especially prevalent in barley, but are common also in wheat and rye. Another species, the *Oscinis frit* L., or frit fly, is especially abundant and injurious over northern Europe, attacking principally oats and barley, and constituting one of the most important pests of these crops. The maggots work in the stems of the host plants, about the level of the ground, causing these to wither and die. Injury by a second brood in the heads of these grains causes a blighting of the grains, producing the condition known in Swedish as "frits" from whence the name.

Oscinis theæ is sometimes injurious to tea in Ceylon, the maggots mining the leaves. A species of *Agromyza* mines the stems of peas in India, while still another form mines the leaves of cruciferous plants.

COLEOPTERA.

Byturidæ.

A single species in this family is regarded as quite troublesome in England, and occurs in France and Germany, namely, *Byturus tomentosus* Fabr. It attacks raspberries, and the greater part of the fruit is stated often to be injured and made unfit for market purposes. The beetles nip off the blossoms and the larvæ infest and feed upon the fruit. It will be recalled that our species, *Byturus unicolor* Say, infests raspberries in the same way, but is apparently much less important than its European cognener.

Buprestidæ.

Capnodis tenebrionis L., distributed over southern Europe, attacks *Prunus spinosa* L. and various fruit trees, working something like our *Chrysobothris femorata*. *Sphenoptera neglecta* Klug attacks cotton throughout the northern Nile provinces, the larvæ hollowing out the stems.

A similar (perhaps identical) species, *S. gossypii* Kerr., injures cotton in the same way over the cotton area of India. *S. hypogea* is a serious enemy of peanuts in South India, the larvæ boring into the underground root stalks. *Agrilus grisator* Kerr. bores in lemon trees in the same territory, while the larvæ of *Belionata parasina* Thunb. is also common in India and bores the trunks of guava and mango plants. Small leaf-mining Buprestids, *Aphanisticus consanguineus* Rits. and *A. krügeri* Rits. attack sugar cane in Java, though the injuries have not been very important up to the present time.

Bostrychidæ.

Dinoderus minutus Fabr. is common in the bamboo in India, and has been reared from cut sugar cane. *Rhizopertha collaris* Erichson bores into the limbs and branches of the apple in Australia, and is regarded as quite troublesome. *Bostrychopsis jesuita* Fabr. is the orange and fig borer of Australia, though it attacks also lemon and apple. The female places her eggs just beneath the bark, and the larvæ tunnel the hard wood mostly longitudinally. On account of its borings, it has been called the augur beetle.

Scarabaeidæ.

An important European member of this family is the *Melolontha melolontha* L., the common cockchafer, or May-bug. It is injurious in both the larval and adult stages, the grubs feeding on the roots of grasses, vegetables and young trees, and the adults upon foliage of elm, oak, etc., often completely stripping the trees. Most European works on practical entomology give this species extended attention, perhaps more on account of its commonness than its real importance as a pest. In India, *Anomala varians* Oliv. is injurious to rice and other cereals, the larvæ feeding on the roots. *Anomala vitis* Fabr. injures the grape in Europe, Algeria and Tunis, the adults feeding on the foliage and the larvæ on the roots of the plant, and also on roots of various grasses. One of the very troublesome sugar-cane pests of Porto Rico is a species of *Lachnosterna*, the grubs of which devour the roots of the plant. The control of this insect is one of the acute problems before the sugar-cane planters of the Island. *Ligyryus bituberculatus* Beauv.

is of interest by reason of its attacking bananas in certain islands of the West Indies. The grubs tunnel the roots of the banana plant, and their injuries are apparently important.

Phytalus smithi Arrow is destructive to sugar cane in Mauritius where it has evidently been introduced from Barbados, its native home. On one occasion 1,372,000 beetles were captured by the natives, who placed small branches in the ground upon which the beetles climbed. *Holotricha vidua* is reported as the most destructive enemy of sugar cane in the Philippines and has necessitated the abandonment of certain fields. In India, Ceylon, Straits Settlements, Philippines, etc., *Oryctes rhinoceros* L., eats into the soft tissues of young palms, often killing the trees. *Diphucephala colaspoides* injures fruit trees in Australia, especially cherry. The beetles come from the ground about "cherry time" and often in such countless multitudes as to strip a good sized tree in a very few minutes. *Apogonia destructor* R. Bos., as well as a related species, *A. ritsemæ* Sharp, are destructive pests of sugar cane in Java, injuring the roots of the plants like *Lachnosterna* sp. in Porto Rico. *Heteronychus morator* F., in the adult stage, attacks the young cane at the base in Java, often boring in the canes. *Xylotrupes gideon* L. also bores sugar cane in the Straits Settlements. *Anisoplia austriaca* Herbst., in Austria, Hungary and southern Russia, is one of the very troublesome Scarabids attacking cereals about blooming time, destroying the heads.

Cerambycidae.

Xylotrechus quadripes Chev. is a serious enemy of coffee in Southern India, Assam, Sylhet and Burmah, the larvæ boring the stems of the plant, especially those shaded. *Caloclytus annularis* Fabr. injures the bamboo, the larvæ destroying the plants by their borings. *Calamobius marginellus* Fabr. is a European species which injures wheat. The adult oviposits below the head which the resulting larva injures. *Batocera rubus* L., occurring in southern India and Ceylon, is one of the large beetles found throughout the plains, the larvæ being common under the bark of felled trees. The beetles penetrate the trunk of young coconut trees and there deposit eggs, the grubs eating to the top, thus destroying the leaves. The mango is also injured. This species has been recently introduced in Barbados, where it is doing considerable injury. An allied species, *Melanauster chinensis* Forst., is very injurious to fruit trees in Japan and China. *Apomecyna pertigera* Thoms. and *A. histrio* F., are common insects on cultivated crops in India, the former attacking cucurbits. *Acanthophorus serraticornis* Oliv. bores the mango in southern India, while *Plocoderus obesus* Gah. infests Sal wood, the larvæ making large cocoons apparently of

calcium carbonate. *Uracanthus acutus* Blackl. injures peaches, apricots and plum in Australia. *Steirastoma depressum* L., the cacao beetle, is the most serious pest of cacao in the West Indies, and the Guianas the larvæ living under the bark of the tree, and also boring the heart wood. *Diploschema rotundicolle* Serv. bores the orange in Brazil and is evidently a serious enemy of this plant. *Apriona rugicollis* Chev. is a mulberry pest in Japan. The females oviposit on the branches, the larvæ boring into the wood. Three years are required for the life cycle.

Chrysomelidæ.

In this family are quite a number of injurious forms in different parts of the world. The group ranks close to the Curculionidæ in economic importance. *Lema flavipes* Suffr. is injurious to rice in Japan, in both the larva and adult stages. *Hispa callicantha* Bat. also injures rice in the same country, both adults and larvæ feeding on the foliage. *Crioceris merdigera* L., cogenetic with our asparagus beetles, is distributed over all Europe and is a decided pest of lillies in France, both the larvæ and adults feeding on the foliage, the former protected by their excrementitious covering. *Pachnophorus bretinghami* Jac. and *P. impressus* Ros., replace, in India, *Myochrous* in America. They are quite injurious to the young shoots of sugar cane and to cereals. *Chrysochrous chinensis* Baly injures the sweet potato in Formosa. *Galerucella tenella* L. is common over Europe and attacks the strawberry, though not as yet important apparently. *Galeruca semipullata* in Australia, infests wild and cultivated figs, the dirty yellow larvæ feeding on the leaves. *Chatocnema concinna* Marsh, of Europe, is a pest of hops, the beetles defoliating the plants, attacking also the shoots. *Chatocnema basilis* Baly is a rice flea beetle in India, and other species injure various crops. *Haltica ampelophaga* Leeb., the grape flea beetle of Europe is one of their more important vineyard pests. *H. indigacea* Illig. in Cape Colony, is injurious to buds and foliage of fruit trees in spring.

Hispa ænescens By. is a very important rice pest in India. *H. modesta* We. has been reared from sugar cane in the same country. *Leptispa pygmaea* Baly attacks rice in Malabar. *Brontispa froggatti* Sharp, the palm leaf Hispa, injures the foliage of its host plants in New Britian and Solomon Islands generally.

Scelodnota strigicollis Mots. is a pest of grapes in India. Its habits are thought to be like those of our *Fidia viticida*. *Odon-tonopa sericea* Gyll., in South Africa, injures buds and leaves of fruit trees in the spring.

Aulacophora hilaris Bvd. is a serious pest of cucurbits in Australia, where it is known as the banded pumpkin beetle. This, or

a related species (*olivieri*) is considered the worst leaf-eating pest with which gardeners have to deal, attacking also the fruit of the cherry. Another species, *A. foveicollis* Kuest. is a cucurbit pest of importance in Formosa, India, etc. and, *A. exacavata* Baly is present along with the former, and has about the same habits.

RHYNCHOPHORA.

Among the Rhynchophora are to be listed very many of the worst insect pests of the world, and the number of species to be noted in the present connection is relatively large.

Anthribidæ.

The apple beetle of Australia, *Doticus pestilens* Oliff, falls here. It is supposed that eggs are laid in the young fruit. The grubs live in the apples, which, after about a month, shrivel and dry and remain hanging on the trees. The stages of the insect are passed in the fruit, the beetles coming out in the spring, ovipositing in the young fruit.

Curculionidæ.

Several species of *Otiorrhynchus* are to be mentioned. *O. sulcatus* F., native to northern and middle Europe, is now present in New Zealand, Australia and South Africa. It injures both the roots and foliage of strawberry and raspberry plants. *O. corruptor* Host occurs in Italy and attacks the foliage of the grape and almond. *O. singularis* L. is a pest of raspberries in Europe. The beetles eat the fruit buds, blossoms and foliage and gnaw the bark of tender shoots. The grubs feed on the roots of the raspberry and various other plants. *O. lævigatus* Fabr., occurring over middle Europe, is injurious to buds and shoots of plum, and *O. ligustici* L. in central and southern Europe, attacks grape, peach and hops, etc., injuring the leaf and fruit buds, as well as the shoots. Several other injurious forms in the genus ought to be mentioned. *Pachneus litus* and *P. azureus* are serious orange pests in Cuba, the larvæ feeding on the roots of the plants. *Phyllobius maculicornis* Germ., *P. oblongus* L., *P. pyri* L., occurring over Europe, attack various fruit trees, as well as *Fagus*, *Quercus*, etc. *Barypithes araneiformis* Schrank, present in central Europe, injures strawberry by eating holes in the green and ripe fruit. *Sitona lineata* L., distributed over Europe, and *S. sulcifrons* Thunb, attack the shoots of peas as they are pushing through the ground, and later, the foliage. *Cleonus luigionii* Motsch. present in central and southern Italy, is quite injurious to the beet, the larvæ boring the roots. *Liparus coronatus* Geoeze, is destructive to carrots in a similar way. *Phytonomus variabilis* Herbst. attacks species of

Medicago, the larvæ feeding on the foliage. The species is present over Europe. *Euscepes batata* Waterhouse, the so called "scarabee" or "Jacobs" of the West Indies, is a very important pest of the sweet potato, the tubers of which the larvæ tunnel. It is also present in Hawaii. *Cryptorhynchus gravis* Fabr. is the mango weevil of eastern Bengal and Assam, while *C. mangiferæ* Fabr., is the common species in South India and Ceylon. Mango weevils are, without doubt, the most serious pests of the mango in oriental countries. The latter species is said now to inhabit all the mango regions bordering the Indian Ocean, and adjacent islands, and occurs through the East Indies, the Philippines and other groups of South Pacific Islands. It is present in South Africa, Madagascar and other places. *Ceutorrhynchus pleurostigma* Marsh, ranging over Europe, is destructive to cruciferous plants, as is also *C. assimilis* Payk, of similar habits. Another species, *C. napi* Gyll., is also injurious to cabbage. Two species of *Baris* also attack cabbage, namely, *B. cuprirostris* F. and *B. chlorizans* Germ. *Rhynchophorus ferrugineus* F. is the red palm weevil of India and Ceylon, infesting the toddy and coconut palms. The eggs are placed at a wound or cut in the soft tissues at base of leaf sheath, the larvæ tunnelling through the tissues in all directions, making a cocoon of twisted fibres. *R. palmarum* L. is the palm weevil of Brazil, Cayenne, Surinam, the West Indies, and probably occurs on tropical coast of South America generally. The palm weevil is recorded as also attacking sugar cane in Trinidad. *R. cruentatus* Fab. occurs in Florida.

Sphenophorus obscurus Boisd. is the destructive sugar-cane borer in Tahiti, Hawaii, New Guinea, Fiji, etc.,. It is widely spread but is not on the mainland of the United States. It also attacks the coconut. The female enters between a leaf sheath and the stem. A small cavity is cut with the mandibles, in which an egg is placed. The resulting grub tunnels upward in the cane, making occasional apertures to the exterior. *S. sericeus* Oliv. is a well known enemy of sugar cane in the West Indies, where it is designated the weevil borer. *S. sordidus* Germar injures the banana in the West Indies and is especially complained of in Fiji. The young suckers are attacked and quickly killed by the larvæ boring in the base of the plants. It is said to occur from the South Pacific Ocean to the Islands of the Indian Archipelago.

Balaninus nucum L., the nut weevil of Europe, is commonly injurious to the filbert, cob and wild hazelnut. Other species present in Europe are of more or less importance, as *B. cerasorum* Hbst., attacking sour and sweet cherries, and *B. elephas* Gyll., attacking chestnuts.

On of the weevils of Europe which has not yet reached the United States, and which is without doubt a first class pest of the apple is

Anthonomus pomorum L. The female deposits eggs in unopened flower buds and blossoms of the apple. Its injuries were recorded as early as 1801, and there is now a considerable European literature on the species. Cold, damp weather, retarding the opening of apple blossoms, is said to be quite favorable to it. The symptoms of injury are the scorched appearance of the blossoms, and their failure to open normally.

A. rubi Herbst., in Europe, injures the raspberry in about the same manner as the foregoing. The weevils of the new generation puncture the shoots and feed on the foliage. *A. rectirostris* L. attacks stone fruits in Europe, especially cherries. The grub infest the pits or seeds like our *Coccotorus prunicida* apparently. The cotton square weevil of Peru, species of *Anthonomus*, probably *vestitus* Boh. injures cotton in a way similar to *A. grandis*. *A. varipes* DuVal injures the egg plant in Cuba, the beetles feeding on the tender buds. *Magdalis* is well represented in Europe by species occurring on useful plants. *M. armigera* Geoff. infests branches of plum trees. *M. barbicornis* Latr., the branches of apple, quince, etc. *M. cerasi* L., cherry and plum; *M. duplicata* Germ., pear; *M. ruficornis* L., various orchard trees, and *M. violacea* L., the pear. *Apion apricans* Hbst., of Europe, attacks red and purple clover. Eggs are placed in the blossom heads, the larvæ eating the unripe seeds, reducing seed production. There are several broods each year. *Rhynchites cæruleus* DeGeer oviposits in tender shoots of apple, and then cuts off the twig just below the point of insertion of the egg. Considerable injury is thus done to young growing trees. The insect occurs over Europe. *R. ruber* Fairm, occurring in Greece, Corsica, Crete, etc., is a very local species, but which is quite a pest of the olive. The female oviposits in the fruit in which the grubs feed much like our *Conotrachelus nenuphar*. Other species of *Rhynchites* are of more or less prominence in Europe to one plant or another, as *R. bacchus* L., *cupreus* L., *interpunctatus* Steph., etc. *Bytiscus betulae* L., distributed over Europe, Asia, Siberia, etc., injures numerous plants in its range, and is especially likely to attack the grape. *Diaprepes abbreviatus* is present generally throughout the West Indies, where it is destructive to sugar cane, especially in parts of Barbados. *Rhinaria perdix* Pascoe is a serious enemy of strawberry in Victoria and Tasmania, and to a less extent, raspberries. Both adults and larvæ are destructive, though the larvæ more so as they feed on the central "bud" of head of the plant, thus often killing the plants outright. *Rhadinosomus lacordairei* is said to be the worst insect enemy of strawberries in Tasmania, and occurs in all of the Australian States, and perhaps in New Zealand. Another Australian pest is *Leptops hopei* Fahrs., which is said to be one of the most troublesome insects of Victoria, attacking especially apples and pears. Eggs

are laid in batches on the leaves, and the grubs crawl down in the soil and feed on the roots in which they cut galleries and furrows, often largely devouring them. *Metatygus turritus* Pasc. is quite injurious to figs in Natal and the east coast generally. Eggs are laid in the fruit in which the grub feeds. The species is two-brooded. *Echinocnemus squameus* Billb. is a rice pest in Formosa, the larvæ feeding on the roots. A species of *Phylaitis* bores the stems of cotton in South India and Behar, from the effect of which the plants become weakened, break off and die. *Orthorrhinus klugi* Sch. is injurious to grape in Australia, the larvæ hollowing out the canes. Another species of the same genus, *O. cylindri-rostris* Fabr., is a pest of the orange. The eggs are laid in the bark of the tree, a foot or so from the ground, the larvæ boring into the wood in all directions. The tomato weevil of Victoria, *Desiantha nociva* Lea, has attracted some attention on account of its injuries to tomato. Certain species of *Belus* are regarded in Victoria as serious enemies of the apricot. Adults bore holes in the branches in which the eggs are placed, the grubs tunnelling the branch, thus killing the trees. The species mentioned are *B. bidentatus*, *B. suturalis*, *B. irroratus*, *B. centralis* and *Belus* sp.

HYMENOPTERA.

Tenthredinidæ.

Allantus cinctus L., distributed over Europe, infests normally the leaves of the rose, wild and cultivated, and is known to attack the raspberry. The prepupal larvæ hollow out the canes, where also they pass the winter, transforming in the spring. *Athalia spinarum* Fabr., occurring in Europe, Algeria, etc., is injurious to the turnip, beet and cruciferous plants, destroying the foliage. *A. proximata* Klug, in India, feeds on cruciferous plants generally and is one of the commonest species of the plains.

Two species of *Hoplocampa* are troublesome pests. *H. testudinea* Klug occurs over central Europe, and is quite injurious to apple in portions of England. The females oviposit in the apple blossoms, the larvæ boring into the young fruit, which later fall. A related, and perhaps identical species, is already established in Washington State, and in British Columbia. *H. fulvicornis* Panz. also ranging over central Europe, attacks the plum after the same manner, and is a pest of importance in England.

P'eronidea leucotrochus Htg. is injurious to gooseberry, the larvæ eating the foliage like *N. ribesii* and is spread over central and northern Europe. *Priophorus padi* L., the plum saw-fly, ranges over central and northern Europe, the larvæ feeding on the foliage, also attacking pear, rose, hawthorn, etc. *Diprion pini* L., distrib-

uted over central and northern Europe, defoliates the pine, as its name indicates, to which at times, it is quite destructive. *Arge rosæ* L. is a rose pest widely spread over Europe, and occurs in Siberia and Asia Minor.

Janus compressus Fabr., of central and southern Europe, deposits its eggs in the buds of the pear, which the larvæ hollow out, and later eat their way into the twig, tunnelling along the pith. *Panphilius flaviventris* Retz is distributed over western Europe. It is known in England as the social pear saw-fly. Eggs are placed in groups of from 30 to 60 on under-surface of pear leaves. The young larvæ at once commence to form a web, which is added to as they grow, sometimes reaching a length of a foot. The larvæ also feed upon plum, cherry, white thorn and other rosaceous plants.

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Commenting on Professor Quaintance's address, Mr. Marlatt said that he had been much interested in the presentation made, and that the subject was most timely in view of the recent enactment of the plant quarantine law which now furnishes, for the first time in the history of the United States, a means of excluding foreign insect pests. It is therefore of especial importance just now to make available a publication which will give descriptions and, so far as possible, illustrations of all known important foreign insect pests, for the guidance of state inspectors and others engaged in plant quarantine and inspection work. He said that he believed Dr. Howard had in view the preparation of a comprehensive bulletin covering this general subject, and that it was to be prepared with the aid of the many experts which Dr. Howard had as his assistants in the Bureau of Entomology. Such a publication, prepared with the aid of these experts and edited by Dr. Howard, should have a comprehensiveness and value which would make it of great usefulness.

The inspection of plant material imported by the Department and other imported plant stock coming to the District of Columbia, largely under the expert management of Mr. Sasser, has shown that much of such imported stock is infested, and the comparison